1 **(a)** Complete the following passage by using the most appropriate terms from the list to fill the gaps. Each term should not be used more than once.

anti-parallel	**β-pleated sheet**	**covalent**
double helix	**hydrogen**	**parallel**
polypeptide	**ribose**	**sugar-phosphate**

DNA is found in the nucleus. The molecule is twisted into a .... in which each of the strands are ..... . It has two ..... backbones attached to one another by complementary bases. These bases pair in the centre of the molecule by means of ..... bonds. **[4]**

(b) Table 1.1 shows the relative proportions of different DNA bases in four different organisms.

Table 1.1

	relative proportions of bases in DNA as a percentage			
organism	A	C	G	T
human	30.9	19.8	19.9	29.4
grasshopper	29.3	20.7	20.5	29.3
wheat	27.3	22.8	22.7	27.1
E. coli	24.7	25.7	26.0	23.6

(i) Describe the patterns shown by the data given in Table 1.1.

.....

.....

.....

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.....

.....

..... **[3]**

(ii) Suggest how the data given in Table 1.1 might have been helpful to scientists in working out the structure of DNA.

.....

.....

.....

..... [2]

(c) DNA in the nucleus acts as a template for the production of RNA.

Complete the table below to show **three** ways in which the structure of DNA differs from that of RNA.

feature	DNA	RNA
number of strands		
bases present		
sugar present		

[3]

(d) DNA codes for the structure of polypeptides.

State the role of messenger RNA (mRNA).

.....

.....

.....

.....

..... [2]

[Total: 14]

2 DNA and RNA are nucleic acids.

(a) (i) State the components of a **DNA** nucleotide.

.....

.....

.....

..... **[3]**

(ii) Describe how the structure of RNA differs from that of DNA.

.....

.....

.....

..... **[2]**

(b) Before a cell divides, the DNA needs to be accurately replicated.

Describe how a DNA molecule is replicated.

In your answer you should make clear how the steps in the process are sequenced.

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..... [7]

(c) (i) State what a gene codes for.

.....

.....

..... **[1]**

(ii) Suggest how changing the sequence of DNA nucleotides could affect the final product the DNA codes for.

.....

.....

.....

.....

..... **[2]**

[Total: 15]

3 **(a)** Fig. 4.1 is a drawing that represents molecules of DNA and messenger RNA (mRNA).

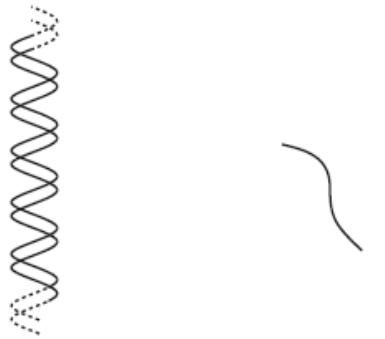

Fig. 4.1

The mRNA molecule is shorter than the DNA molecule.

(i) State, using **only** the information in Fig. 4.1, **one other** way to distinguish between DNA and mRNA.

.....

..... **[1]**

(ii) Give **one** further difference in **structure** between DNA and RNA.

.....

..... **[1]**

DNA and mRNA are both involved in protein synthesis. The mRNA molecule, carrying the code for protein, leaves the nucleus and attaches to a ribosome. The ribosome is the site where a protein molecule is formed.

(iii) Complete the following statement:

A sequence of DNA nucleotides that codes for a protein is a ..... **[1]**

(iv) Suggest why DNA is not able to leave the nucleus.

.....

.....

..... **[1]**

(v) Explain why the mRNA molecule is shorter than a DNA molecule.

.....

.....

.....

.....

..... **[2]**

[Total: 6]

4 **(a)** Fig. 5.1 shows part of a DNA molecule.

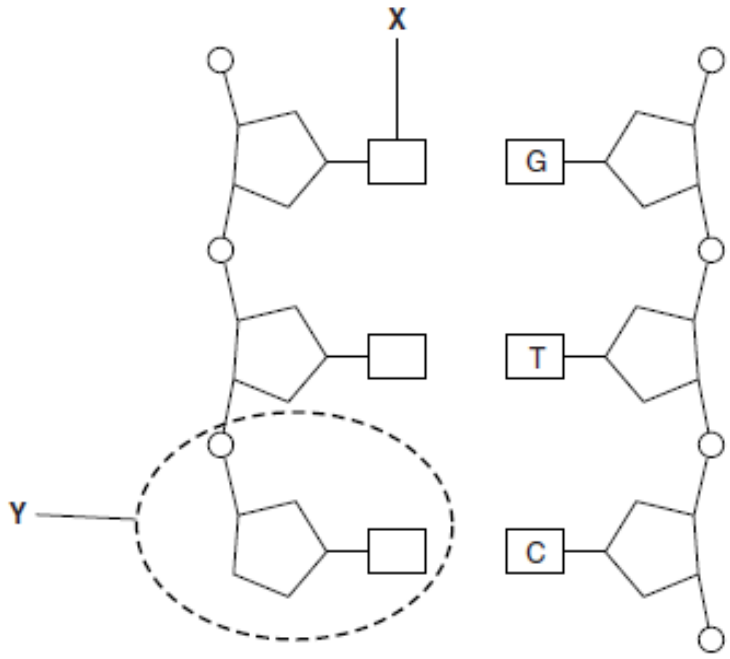

Fig. 5.1

(i) Name the parts of the molecule represented by the letters **X** and **Y**.

X .....

Y .....

[2]

(ii) **Complete the diagram in Fig. 5.1** by drawing hydrogen bonds to connect the two strands.

The hydrogen bonds should be drawn on Fig. 5.1. **[2]**

(iii) Complete the following paragraph by using the most appropriate term(s).

A gene is a section of DNA that codes for the production of a ..... .

The molecule that copies a gene and carries the information to a .....

is called RNA. **[2]**

(iv) State **two** ways in which a diagram of part of an RNA molecule would appear different from the DNA molecule shown in Fig. 5.1.

1 .....

.....

.....

2 .....

.....

.....

[2]

(b) DNA replication takes place during interphase of the cell cycle. It occurs by a semi-conservative mechanism.

(i) Explain why DNA replication is considered to be semi-conservative.

.....

.....

.....

.....

..... **[2]**

(ii) Explain why complementary base-pairing is important in DNA replication.

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..... **[2]**

(c) In 1958, two scientists, Meselson and Stahl, conducted an investigation into DNA replication.

- Bacteria were grown in a food source that contained only the 'heavy' isotope of nitrogen, ^{15}N. After many generations, the bacterial DNA contained only the 'heavy' form of nitrogen.
- Some of the bacteria were then transferred to another food source containing only the normal, 'lighter' form of nitrogen, ^{14}N.
- DNA was extracted from the bacteria and centrifuged. (When a solution is centrifuged, the heavier, more dense molecules tend to settle nearer the bottom of the tube.)

Some of the results from the experiment are shown in Fig. 5.2.

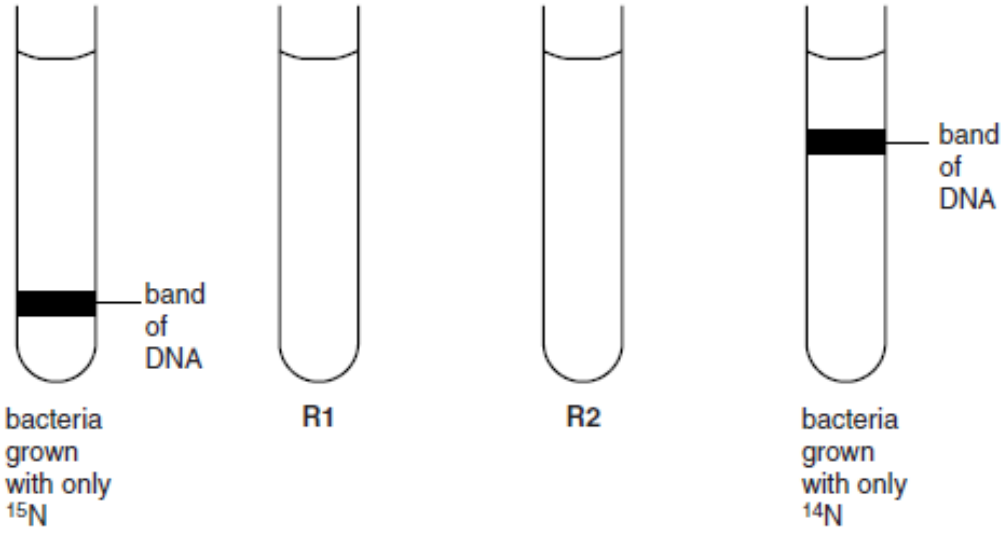

Fig. 5.2

(i) In Fig. 5.2, the tube labelled **R1** represents the results for DNA extracted from bacteria that had been **transferred** from the ^{15}N to the ^{14}N food source and left long enough for their DNA to replicate **once** only.

Draw **one** band on tube **R1** in the position you would expect the DNA to appear **after** centrifuging.

Draw the band on Fig. 5.2. **[1]**

(ii) In Fig. 5.2, the tube labelled **R2** represents the results for DNA obtained from bacteria that had been **transferred** from the ^{15}N to the ^{14}N food source and left long enough for their DNA to replicate **twice**.

Draw **two** bands on tube **R2** in the positions you would expect the DNA to appear **after** centrifuging.

Draw the bands on Fig. 5.2. **[1]**

(d) The technique of centrifugation used by Meselson and Stahl involves:

- mixing the DNA sample with concentrated sugar solution
- placing the mixture of DNA and sugar solution in test-tubes
- spinning the test-tubes at a very high speed.

Suggest **three** precautions that Meselson and Stahl would have taken in order to ensure that the centrifugation part of their investigation produced valid results.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

[Total: 17]